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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/759,083	01/20/2004	Yasuji Hiramatsu	247814US90CONT	7152

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EXAMINER	
WILLIAMS, ALEXANDER O	

ART UNIT	PAPER NUMBER
2826	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/759,083	HIRAMATSU	
	Examiner	Art Unit	
	Alexander O. Williams	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 December 2005*.

2a)☒ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *38-67* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *38-67* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/21/06 & 12/29/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☒ Other: *See Continuation Sheet*.

Continuation of Attachment(s) 6). Other: IDS filed 1/20, 3/22 adn4/16/04.

Serial Number: 10/759083 Attorney's Docket #: 247814US90CONT
Filing Date: 1/20/2004; claimed foreign priority to 3/7/2000

Applicant: Hiramatsu et al.

Examiner: Alexander Williams

This application is a 371 of PCT/JPO1/01787 filed 3/7/2001.

Applicant's Amendment filed 12/29/05 has been acknowledged.

Applicant's election of the species of figures 3 and 4 (claims 6 to 37), filed 9/8/05, continues to be acknowledged for examination in this application.

Claims 1 to 37 have been cancelled.

The disclosure is objected to because of the following informalities: Applicant's related application information should be updated.

Appropriate correction is required.

Claims 38-67 are rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claims 38-67, it is unclear and confusing to how these claims relate to the elected species of figures 3 and 4? This application is a continued prosecution of the claims related to the elected species of figures 3 and 4. The claims related to this elected species will be examined only at this time. Applicant's previous claims were directed to a ceramic heater and Applicant's newly added claims are directed to just the ceramic substrate. Applicant's current claims appear to be of several species. For

example, a conductor on the surface of the ceramic substrate verses a conductor inside of the ceramic substrate are different species. Which new claims are related to the elected species of figures 3 and 4? If applicant desire to prosecute other non-elected species other than the elected species in this application and the other species are not a part of an potential generic claim(s) of this applicant, those non-elected species should be considered for a divisional application.

Any of claims 38-67 not specifically addressed above are rejected as being dependent on one or more of the claims which have been specifically objected to above.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. § 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

Claims 38-49, **insofar as they can be understood**, are rejected under 35 U.S.C. § 102(e) as being anticipated by Yushio et al. (U.S. Patent # 6,423,400 B1).
38. For example, Yushio et al. (figures 1 to 3) specifically figure 2a show a ceramic substrate **11** for a semiconductor producing/examining device having a conductor **9** formed inside of the ceramic substrate, wherein said ceramic substrate has an impurity element-existent area where an impurity element is locally distributed in triple points of crystal grains, and an impurity element-nonexistent area where an impurity element is not locally distributed in the triple points of crystal grains.

Claims 38-67, **insofar as they can be understood**, are rejected under 35 U.S.C. § 102(e) as being anticipated by Zsamboky (U.S. Patent # 5,100,714).

38. For example, Zsamboky (figures 1 to 15) specifically figure 2 show a ceramic substrate **22** for a semiconductor producing/examining device having a conductor **20** formed inside of the ceramic substrate, wherein said ceramic substrate has an impurity element-existent area where an impurity element is locally distributed in triple points of crystal grains, and an impurity element-nonexistent area where an impurity element is not locally distributed in the triple points of crystal grains.
50. For example, Zsamboky (figures 1 to 15) specifically figure 4 show a ceramic substrate **62** for a semiconductor producing/examining device having a conductor **60** formed on a surface of the ceramic substrate, wherein said ceramic substrate has an impurity element-existent area where an impurity element is locally distributed in triple points of crystal grains, and an impurity element-nonexistent area where an impurity element is not locally distributed in the triple points of crystal grains.

ABSTRACT:

A metallized ceramic substrate having an enhanced bond strength between the ceramic substrate and a conductive metal layer bonded thereto is disclosed. The metallized ceramic substrate includes a heterogeneous juncture band between a ceramic workpiece and a layer of electrically conductive material. A process for making the metallized ceramic substrate is also disclosed. The process includes an acid etchant step that increases the actual surface area of the treated surface of the ceramic workpiece without undermining the integrity of the ceramic surface while at the same time selectively attacking vitreous binder phase present between substrate grains and creating even deeper penetration at the relatively higher energy triple point junctures. In this manner, metal anchor sites that enhance adhesion are provided. During subsequent high temperature firing these anchors hold the resulting composite together as a chemical bond is formed in addition to a mechanical bond or interlock.

(2) A metal-ceramic composite or workpiece embodying the present invention exhibits an exceptionally strong bond between a metal layer that overlies a ceramic substrate and the substrate itself. This is believed to be the result of a heterogeneous juncture band between the metal and the ceramic within which the metal composition that is present adheres to a working surface of the substrate that is much larger in area than the respective apparent surfaces of the metal layer and the ceramic substrate that are juxtaposed relative to one another in the produced composite. The term "working surface" as used herein and in the appended claims designates a surface, including an interior surface that defines a hole, aperture or cavity in the workpiece, of the ceramic workpiece available for supporting a conductive metal layer.

(3) The juncture band, and thus the resulting metal/ceramic substrate composite is capable of withstanding repeated firing cycles at a temperature in excess of 850.degree. C. (1562.degree. F.). Heretofore no metal/ceramic composite that includes an electroless conductive metal layer has been able to achieve such a performance level. Within the juncture band ceramic grains unitary with the substrate define therebetween interstitial spaces that are substantially filled with the conductive metal and/or a conductive metal composition that may be a lower melting eutectic or alloy of the conductive metal, such as copper.

(4) A typical juncture band when copper is the conductive metal is at least about 8 micrometers thick, and preferably about 9 to about 13 micrometers thick. The interstitial spaces between individual grains provide a relatively large number of metal penetration sites into the ceramic material, typically of the order of about 15,000 penetration sites per linear inch (about 225 million sites per square inch). As a result of such penetration sites, metal fingers or anchors unitary with the deposited conductive metal layer extend into the ceramic substrate to a depth of about 0.0005 inch and anchor the conductive metal layer to the substrate.

(5) Moreover, such penetration sites also permit effective conductive metal layer deposition within through holes or apertures machined or formed into the ceramic substrate, thereby providing an effective electrically conductive path through the holes or apertures from one surface of the ceramic substrate to another surface without the need for conductive rivets or the like expedients that have to be utilized with metal-ceramic composites made by techniques that bond a discrete, conductive metal foil to a ceramic substrate.

(18) FIG. 2 on the other hand shows a section of a metal-ceramic composite 12 embodying the present invention. The photomicrograph was taken under the same magnification as FIG. 1 (1000.times.). Specifically, composite 12 is constituted by copper layer 20 coextensive with ceramic substrate 22. Copper layer 20 is about 0.00013 inch thick. The copper-ceramic interface is substantially more irregular than the surface of the control (FIG. 1) and thus provides a working surface having an increased metal-wetted ceramic contact area between the metal layer and the underlying ceramic substrate. Below the copper layer 20 is seen juncture band 14 defined by metal-containing islands 24 distributed among the ceramic grains of the substrate 22 that are monolithic therewith. In this particular instance juncture band 14 has an average thickness of about 0.0005 inch. Further study of this particular sample revealed that the metal-containing islands 24 were conductively connected to copper layer 20 and were sections of metallic penetrations into the ceramic substrate 22. Approximately 15,000 such penetrations per linear inch (about 225.times.10.sup.6 penetrations per square inch) were noted. Frequent individual penetrations as deep as about 0.0005 inch were noted. The average depth of such penetrations was about 0.0003 inch.

(19) FIG. 3 is a photomicrograph of a section of a metal-ceramic composite 34 made by initially depositing electroless copper onto an alkali metal hydroxide-etched ceramic substrate surface (the alkali metal hydroxide-etched substrate method). The photomicrograph was also made under the same magnification as FIG. 1 (1000.times.). The composite 34 is constituted by copper layer 40 that is coextensive with ceramic substrate 42. Copper layer 40 is about 0.00003 inch thick. The copper-ceramic interface is less irregular than the surface of the metal-ceramic composite 12 (FIG. 2) embodying the present invention. Thus, there is less of a metal-wetted ceramic contact area between the metal layer 40 and the underlying ceramic substrate 42. The lesser contact area, in turn, accounts for a lower peel strength.

(21) FIG. 4 is a photomicrograph of a section of a metal-ceramic composite 56 made by juxtaposing a copper foil on a ceramic substrate and then heat-bonding the foil and the substrate (the foil heat-bonding method). The photomicrograph was taken at the same magnification as FIG. 1 (1000.times.). The composite 56 is constituted by copper layer 60 that is not coextensive with the ceramic substrate 62. Copper layer 60 is about 0.00325 inch thick. This absence of coextensiveness is due to blister 69 as well as small voids 68 at the interface between the copper layer 60 and the ceramic substrate 62. Furthermore, there is no penetration of the copper into the ceramic substrate 62. Thus, again there is no heterogeneous juncture band present.

(22) FIG. 5 is a photomicrograph of a section of a metal-ceramic composite 70 in which a plated thick film is applied to a secondary ceramic-glass layer fired onto the substrate (the plated thick film method). See, Jones, "Evaluation of Copper Plated Ceramic Substrates", International Society for Hybrid Microelectronics (ISHM), 1988 Proceedings, Seattle, Wash., pp. 164-169, at p. 165. The photomicrograph was taken at the same magnification as FIG. 1 (1000.times.). The composite 70 is constituted by copper layer 72 that is coextensive with ceramic substrate 74. The copper layer 72 is about 0.00005 inch thick. The copper-ceramic interface is characterized by a few, wide, shallow irregularities as compared to the copper-ceramic interface of the metal-ceramic composite 12 of the present invention (FIG. 2). These large

irregularities do not result in a substrate as occurs when many, narrow, deep irregularities are present as in the present invention.

(41) The foregoing articles of manufacture embodying the present invention are made by depositing a conductive metal on a ceramic blank which is also referred to as a substrate. Examples of such ceramic substrates include aluminum oxide (alumina), aluminum nitride, beryllium oxide (beryllia), beryllium titanate, silicon carbide, silicon nitride, ferrite (a ferrimagnetic material having a spinel structure and high electrical resistivity), or other substrates having similar characteristics. Also suitable is porcelanized metal such as that commercially available from Ferro Corporation, Ohio, under the designation ELPOR II.RTM.. In addition, a product sold by Corning Glass Works (New York) under the name PHOTOCERAN.RTM. is suitable as a substrate. Alumina, beryllia, and aluminum nitride substrates are particularly well suited for practicing the present invention.

(44) The initial layer of conductive metal is placed onto the ceramic substrate by electroless deposition, utilizing a sensitizer/activator process.

(45) For deposition of the conductive metal onto the ceramic substrate, the faces or surfaces of the substrate must be appropriately prepared by surface etching. To that end the ceramic blank is preheated to about 93.degree. C. (about 200.degree. F.) for approximately five to ten minutes and then dipped into a hot, concentrated acid dip to etch the ceramic surface along the ceramic grain boundaries thereof. Preheating of the substrate lessens the thermal shock which the ceramic substrate undergoes when exposed to the heated acid.

(46) The hot acid dip [about 60.degree. C. or above (about 140.degree. F. or above)] etches the surface of the ceramic substrate as well as removes any unwanted vitreous ceramic which may have been produced by the initial laser machining step. This acid treatment tends to condition the surface, and also roughens the surface for better adhesion of the deposited metal. The acid etchant permeates the glassy or vitreous phase binder at the ceramic grain boundaries more readily than the ceramic grains themselves, thus providing a plurality of exposed grains with recessed grain boundary regions and thus an

enhanced surface area that is ultimately wetted by the conductive metal layer to be deposited thereon. A monolithic etched surface is maintained by the substrate, however. While the surface ceramic grains themselves remain unitary with the ceramic substrate and the etched surface is free from particulate material, the acid etchant produces relatively deep crevices or interstices between the individual ceramic grains that are ultimately filled by metal anchors or "fingers" that extend from the metal layer into the interstitial spaces produced by the acid etchant, thereby defining the heterogeneous juncture band. In this manner the ultimately achieved bond strength is substantially enhanced because the effective bonding area between the metal layer and the ceramic substrate is substantially greater, by at least about 100 percent, than the apparent area of the metal layer that overlies the ceramic substrate. For best results, the concentrated acid is heated to near its boiling point so that the etching may take place more rapidly.

(47) The acid dip is prepared from acid etchants capable of etching the particular substrate used, i.e., alumina, aluminum nitride, beryllia, or any of the other ceramic and porcelain substrates mentioned hereinabove. For example, the acid etchant may be phosphoric acid, a halogen acid, i.e., hydrofluoric acid, hydrochloric acid, hydrobromic acid, hydroiodic acid, and the like. In addition, other acid etchants which may be utilized include nitric acid, permanganic acid, fluoboric acid, or any other strong inorganic acid, as well as mixtures thereof. The preferred acid etchant is a hot phosphoric acid solution.

(48) The duration and degree of the acid etch in any given instance depends upon the particular ceramic involved. In all instances, however, the acid etch is carried out for a time period sufficient to remove the vitreous binder present at the grain boundaries of the ceramic substrate without loosening or undermining the individual grains, i.e., while preserving the monolithic character of the ceramic substrate. That is to say, the etching process must not leave loose ceramic particles or residues on the etched ceramic surface. Depth of the acid etch along the grain boundaries of the ceramic substrate extends inwardly from the working surface of the substrate for a distance equal to at least about the diameter of the average grain at the working surface, and preferably deeper, to a depth greater than the diameter of the average grain at the working surface.

(49) Owing to the relatively higher surface energy concentration along intersecting grain boundaries, the acid etch exhibits more aggressive etching action therealong. For example, along the triple point junctures of adjacent grain boundaries the acid etch forms tortuous channels or tunnels within which fingers or anchors of conductive metal are extended during the subsequent electroless deposition step.

Response

Applicant's arguments filed 12/29/95 have been fully considered, but are moot in view of the new grounds of rejections detailed above.

The insertion of Applicant's additional claimed language, for example, "new claims 38-67" cause for further search and consideration to make this action final.

Applicant's amendment necessitated the new grounds of rejection. Accordingly, **THIS ACTION IS MADE FINAL**. See M.P.E.P. ∋ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 C.F.R. ∋ 1.136(a).

A SHORTENED STATUTORY PERIOD FOR RESPONSE TO THIS FINAL ACTION IS SET TO EXPIRE THREE MONTHS FROM THE DATE OF THIS ACTION. IN THE EVENT A FIRST RESPONSE IS FILED WITHIN TWO MONTHS OF THE MAILING DATE OF THIS FINAL ACTION AND THE ADVISORY ACTION IS NOT MAILED UNTIL AFTER THE END OF THE THREE-MONTH SHORTENED STATUTORY PERIOD, THEN THE SHORTENED STATUTORY PERIOD WILL EXPIRE ON THE DATE THE ADVISORY ACTION IS MAILED, AND ANY EXTENSION FEE PURSUANT TO 37 C.F.R. ∋ 1.136(a) WILL BE CALCULATED FROM THE MAILING DATE OF THE ADVISORY ACTION. IN NO EVENT WILL THE STATUTORY PERIOD FOR RESPONSE EXPIRE LATER THAN SIX MONTHS FROM THE DATE OF THIS FINAL ACTION.

The listed references are cited as of interest to this application, but not applied at this time.

Field of Search	Date
U.S. Class and subclass: 257/703,700,701,758,705,707,728,758,620 219/270,267-269,552,553,444.1,460.1,544 313/118 361/234 428/689,698 501/98.4,152,98.5 279/128 264/643,614,619,662	9/28/05 3/17/06
Other Documentation: foreign patents and literature in 257/703,700,701,758,705,707,728,758,620 219/270,267-269,552,553,444.1,460.1,544 313/118 361/234 428/689,698 501/98.4,152,98.5 279/128 264/643,614,619,662	9/28/05 3/17/06
Electronic data base(s): U.S. Patents EAST	9/28/08 317/06

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Alexander O. Williams whose telephone number is (571) 272 1924. The examiner can normally be reached on M-F 6:30AM-7:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn can be reached on (571) 272 1915. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Alexander O Williams
Primary Examiner
Art Unit 2826

AOW
3/18/06